

An evergreen tree, 8–16 feet high, with a trunk 8 inches in diameter: leaves $1\frac{3}{4}$ –4 inches long, 5–12 lines broad, on a petiole $1\frac{1}{2}$ –2 lines long; peduncle $1\frac{1}{4}$ – $1\frac{3}{4}$ inch long, gradually thickening to the summit; sepals 4 lines long, 3 lines broad, free and attached to the margin of the thickened apex of the peduncle, each with seven parallel nervures; petals 9–11 lines long, 4–5 lines broad, including the inflected margins, with three apical teeth 1 line long, glabrous; columnar disk 1 line high, 2 lines in diam., glabrous; filaments 3 lines, anthers 5 lines long; scabridly rugulose; ovary 3 lines long, 2 lines broad; style 4–7 lines long; capsule 8–10 lines in diameter; seeds at least 2 lines in diameter, attached to the central column*.

VII. — *Notes on the Palæozoic Bivalved Entomostraca.*
 No. VIII. *Some Lower-Silurian Species from the Chair of Kildare, Ireland.* By Prof. T. RUPERT JONES, F.G.S., and Dr. H. B. HOLL, F.G.S.

[Plate VII.]

IN 1863 Mr. W. H. Baily, F.G.S., Palæontologist of the Geological Survey of Ireland, sent us, from the mountain near Kildare known as the Chair of Kildare†, some of the grey, crystalline, encrinital limestone, of “Caradoc-Bala” age, containing the minute fossils referred to by Prof. M’Coy, in Sir R. Griffith’s ‘Synopsis of the Silurian Fossils of Ireland,’ p. 58, as *Cythere phaseolus* of Hisinger. In 1865 Mr. Joseph Wright, F.G.S., of Cork, visiting the Chair of Kildare, brought away a quantity of this limestone to examine at his leisure; and having broken it up and picked out the separate fossils, he found many of these little Entomostraca, and sent us a liberal supply of them for examination. These specimens are all smooth calcareous representatives of closed carapaces: they may be said to consist of the carapace-valves replaced by calcite and filled with the same; while a very thin film of pulverulent calcareous material sometimes represents the outermost portion (or surface) of the valves.

It has been difficult to find alliances for these Lower-Silurian Entomostraca, simple as they are in form and structure; but since our determination of the Silurian *Primitiæ* of the

* A representation of this plant, with particulars of its floral structure, will be seen in plate 83 A of my ‘Contributions.’

† See the explanatory memoir entitled ‘Data and Descriptions to accompany Quarter-Sheet 35 N.E. of the Map of the Geol. Survey of Ireland,’ 1858.

Malverns and elsewhere, described in the 'Annals Nat. Hist.'* ser. 3. vol. xvi. (1865), pp. 414-425, pl. 13, we have a clearer view of the probable relationship of some of these specimens from Kildare; whilst others of them fall into the groups of *Cythere* and *Bairdia*, as recognized by the shape of the carapace-valves. *Primitia* is a characteristically Silurian genus † (see Ann. Nat. Hist. l. c.); and now *Cythere* and *Bairdia* are shown to have existed at that early period, judging from fossil carapaces, such as already have been accepted as evidence of the persistency of these genera from the Upper-Palæozoic (Carboniferous) times to the present day.

1. *Primitia Maccoyii* †, Salter, sp. Pl. VII. figs. 1 a-c,
2 a & b, 3 a-e.

Cythere phaseolus, M'Coy (not of Hisinger), Synops. Sil. Foss. Ireland, 1846, p. 58.

Cythere Maccoyii, Salter, in Morris's Catal. Brit. Foss. 2nd edit. 1854, p. 105.

Cythere Maccoyii, ("Forbes, n. s.?"), Baily, Descript. Quarter-Sheet 35 N.E. Geol. Surv. Ireland; 1858, p. 10.

Cythere? phaseolus § (M'Coy, not of Hisinger), Salter, in Murchison's 'Siluria,' 2nd edit. 1859, p. 538, and 3rd edit. 1867, p. 517.

Carapace like a bean, smooth, subovate, swollen in the middle and equally compressed at the ends; somewhat Leperditoid in outline, having a nearly straight dorsal line and slightly sloping antero- and postero-dorsal margins, and being somewhat narrower at one extremity than at the other. Dorsal profile acute-oval (in some specimens rather acute-ovate). At the middle third of the hinge-line the edge of each valve is suddenly depressed, and the boundary of the inflection is rounded in the young and slightly ridged in the old specimens. The ventral border of each valve is thickened with a rim, which is doubled in large and aged individuals.

* In this paper on *Primitiæ*, at p. 417, the name "Schrenk" is twice printed by mistake for Schmidt; also in the footnote at p. 424.

† To the already recorded *Primitiæ* (Ann. Nat. Hist. l. c.) we wish to add two, namely, (1) *Cytheropsis rugosa*, Jones (Ann. Nat. Hist. ser. 3. vol. i. p. 249, pl. 10. fig. 5, figured upside down) from the Trenton Limestone of Canada, which in shape much resembles *Primitia semicircularis*, J. & H., whilst its punctation is such as we see in *P. variolata*, J. & H.; (2) *Leperditia Solvensis*, Jones, a very small Leperditoid Entomostracan, without eye-tubercle or muscle-spot, from the Lower Lingula-flags, of Upper Solva, on the west side of Solva Harbour, near St. David's, South Wales (see Annals Nat. Hist. ser. 2. vol. xvii. p. 95, pl. 7. fig. 16; and Quart. Journ. Geol. Soc. vol. xx. p. 238).

‡ For the relative sizes of the *Primitiæ* &c. described in this paper, see further on, page 58.

§ Specimens from the Chair of Kildare are also referred to, in the 'Catal. Collect. Fossils Mus. Pract. Geol.' 1865, p. 7, as "*Cythere phaseolus*, case 7, tablet 37, specimen 15."

As one valve does not overlap the other in this Entomos-tracan, it is not a *Leperditia*; and the absence of both eye-spot and muscle-spot also distinguishes it from that form and the allied *Isochilina*. The acutely elliptical depression of the dorsal margins and the ventral rims remind us of similar features in *Primitia cristata*, *P. umbilicata*, and *P. tersa* (Ann. Nat. Hist. *l. c.* pl. 13. figs. 1-3); and a ventral rim is characteristic also of other *Primitie*, whether the median pit or furrow is present or not.

P. Maccoyii is very abundant in the limestone of the Chair of Kildare.

Several years since, Mr. Salter intimated that this fossil could not be the same as Hisinger's *Cythere phaseolus*. The latter, we know, is a *Leperditia* closely related to (or the young of) *L. Balthica*; and, though figured roughly in Hisinger's 'Lethæa Suecica' (pl. 1. fig. 1), with a mere ovate outline (as, indeed, *L. Balthica* also was at first), it is really Leperditoid in shape, and has other characters of the genus.

An individual *P. Maccoyii* is present in one of the specimens of Bala-Caradoc limestone from Aldeans*, on the Stincher (or Stinchar) River, in Ayrshire†, preserved in the Woodwardian Museum at Cambridge, and, indeed, appears to have been noticed, though not recognized, by Prof. M'Coy (see Ann. Nat. Hist. ser. 2. vol. viii. p. 387; and further on, p. 60).

In the equivalent limestone of Keisley, in Westmoreland, which has a close affinity, both in fossils and mineral character, with that of the Chair of Kildare, *P. Maccoyii* has been discovered by Prof. Harkness (see his account of the Lower Silurian Rocks of Westmoreland, Quart. Journ. Geol. Soc. vol. xxi. pp. 243 &c.).

2. *Primitia Sancti-Patricii*, n. sp. Pl. VII. figs. 4 a, 4 b.

Carapace smooth, almost semicircular in outline, convex in the middle and nearly equally compressed towards the margin all round; back very slightly arched, rounded at the end of the hinge-line; one extremity rather more broadly curved than the other; ventral margin fully convex, and bordered (especially posteriorly) with a faint rim where the edge of the valve turns inward. Dorsal profile acute-oval.

Rather more semicircular than *P. obsoleta*, this Irish species differs from it also in having less of the marginal rim and no sulcus, and in being more oval than ovate in the profile of the closed valves. Indeed it seems to be intermediate between *P.*

* Also written Aldens and Aldons.

† Rep. Brit. Assoc. for 1850, Trans. Sect. p. 107; Quart. Journ. Geol. Soc. vol. viii. (1851) pp. 139 &c.; and 'Siluria,' 3rd edit. 1867, p. 156.

obsoleta and *P. ovata*, both of Scandinavian origin (see Ann. Nat. Hist. ser. 3. vol. xvi. pl. 13. figs. 12 & 13). Rare.

1. *Cythere Wrightiana*, sp. nov. Pl. VII. figs. 5 a, 5 b.

Carapace smooth, elongate-reniform or subcylindrical, like a haricot bean; ends nearly equal in curvature and compression; but one (the anterior) is rather more elliptical and rather more compressed than the other; dorsal line elliptic; ventral line slightly sinuate, being somewhat incurved at the middle. Dorsal profile elongate-ovate. Rare.

Modifications of this shape are not uncommon among the carapaces of *Cythere*, both recent and fossil; but we cannot definitely match this form with any known species. The same may be said of those that follow.

We have named this old *Cythere* after Mr. Joseph Wright, F.G.S., to whose care we owe the many well-preserved specimens of Entomostraca that we have seen from Kildare.

2. *Cythere Jukesiana*, sp. nov. Pl. VII. figs. 6 a, 6 b.

Carapace subcylindrical, but very much narrower and rather more compressed at one end (anterior) than at the other,—in fact strongly tapering from the posterior third forwards. The back is arched behind the middle, and the ventral margin is incurved a little in front of the middle. Ends elliptical in curve; the posterior is broader than the anterior extremity. Dorsal profile subovate, acute at the ends and compressed at the sides. Rare.

Named after the Director of the Geological Survey of Ireland.

3. *Cythere Bailyana*, sp. nov. Pl. VII. figs. 7 a, 7 b.

Carapace smooth, somewhat bean-shaped; straight on the back, rounded nearly equally and attenuated at the ends; incurved and compressed at the middle of the ventral region. Dorsal profile acute-oval, laterally compressed. Rare.

Named after the Palæontologist of the Geological Survey of Ireland.

4. *Cythere Harknessiana*, sp. nov. Pl. VII. figs. 8 a, 8 b.

Carapace smooth, nearly ovate; the back is more strongly arched than the ventral edge; and these opposite margins have their greatest convexity in an oblique direction one to the other—that of the ventral margin being in advance of the middle, and that of the back rather behind it. Dorsal profile nearly oval, but subacute at the ends. Rare.

We dedicate this Lower-Silurian species to Prof. Harkness, F.R.S., of Queen's College, Cork, who has laboured on the Palaeozoic rocks of Ireland and the north of England.

1. *Bairdia Murchisoniana*, sp. nov. Pl. VII. figs. 9 *a*, 9 *b*.

Carapace smooth, almost subcylindrical, arcuate, tapering, and compressed at the ends. Anterior end rounded obliquely, posterior obtusely pointed. Dorsal profile narrow and acutely oval. Rare.

This elegant *Bairdia*, resembling to some extent other elongate forms of *Bairdia*, but wanting the broadly produced and hatchet-shaped anterior end of the Carboniferous and Permian *B. curta* and its varieties*, is dedicated to Sir R. I. Murchison, Bart., whose Silurian researches have so greatly aided in elucidating the structure and history of the old rocks of Ireland, as well as of Great Britain and many other parts of the world.

2. *Bairdia Griffithiana*, sp. nov. Pl. VII. figs. 10 *a*, 10 *b*.

Carapace smooth, subdeltoid; back obliquely arched, with steep unequal slopes to the extremities, the anterior of which makes an acute angle with the ventral border, whilst the posterior is obtusely rounded. Ventral border slightly sinuate. Ventral profile acute-ovate, compressed. Rare.

The name of Sir Richard Griffith, Bart, the veteran Geologist of Ireland, is attached to this species.

3. *Bairdia Salteriana*, sp. nov. Pl. VII. figs. 11 *a*, 11 *b*.

Carapace smooth, swollen, subovate; with angular compressed ends, and an acute-oval profile. Rare. To some extent this species resembles a subrhombical variety of *B. plebeia* (see "Permian Entomostraca," in the *Transact. Tyneside Nat. Field-Club*, vol. iv. pl. 11. fig. 12 *a*).

Named in honour of J. W. Salter, Esq., F.G.S., whose researches among Silurian Fossils are well known.

Measurements.

	Length.	Width.	Thickness.
	inch.	inch.	inch.
<i>Primitia Maccoyii</i> , old	0·09	0·0575	0·045
" " <i>intermediate</i>	0·07	0·0525	
" " <i>young</i>	0·0375	0·025	0·02
" <i>Sancti-Patricii</i>	0·05	0·04	0·025
<i>Cythere Wrightiana</i>	0·0675	0·0325	0·0275
" <i>Bailyana</i>	0·055	} 0·0225 }	0·015
" " <i>Jukesiana</i>	0·07	} 0·025 }	0·0225
" " <i>Harknessiana</i>	0·0575	0·0275	0·0325
" " <i>Harknessiana</i>	0·0575	0·0325	0·0325
<i>Bairdia Murchisoniana</i>	0·0525	0·0225	0·0175
" " <i>Griffithiana</i>	0·04	0·0225 nearly	0·015 to 0·0175
" " <i>Salteriana</i>	0·045	0·0225	0·0225 nearly

* *Ann. Nat. Hist. ser. 3. vol. xviii. p. 42.*

From the "Caradoc" or "Bala-Caradoc" formation there are some other Bivalved Entomostraca known, namely:—

1. *Primitia strangulata*, Salter, sp. Ann. Nat. Hist. ser. 3. vol. xvi. p. 416; from Coniston Waterhead, Lancashire; and found also in the "Brandschiefer"* of the Baltic Provinces, according to Schmidt.
- 1 a. ———, var. *α*, *op. cit.* p. 417. Robeston Wathen, Pembrokeshire.
2. ——— *Salteriana*, J. & H., *op. cit.* p. 417. Sholes Hook, Haverfordwest; in the "Brandschiefer" of Wannemois and in the Borkholm bed (Schmidt).
- 2 a. ———, var. *crenulata*, Schmidt, *op. cit.* p. 417. Paggar and Borkholm.
3. ——— *semicordata*, J. & H., *op. cit.* p. 417. Sholes Hook, Pembrokeshire.
4. ——— *matutina*, J. & H., *op. cit.* p. 418. Cheney Longville, Shropshire.
5. ——— *simplex*, Jones, *op. cit.* p. 417. Harnage †, Shropshire; and in the Llandeilo schists of Busaco, Portugal.
6. ——— *bicornis*, Jones, *op. cit.* p. 420. Harnage.
7. ——— *nana*, J. & H., *op. cit.* p. 420. Harnage.
8. *Leperditia* [*Primitia*?] *minuta* (Eichwald, sp.), Schmidt, Untersuchungen, p. 194; in the Brandschiefer and the Wessenberg and Borkholm beds.
9. ——— [——?] *brachynotha*, Schmidt, Untersuch. p. 195; Borkholm.
10. ——— [——?] *obliqua*, Schmidt, Untersuch. p. 195; Borkholm.
11. *Beyrichia complicata*, Salter. Abermarchant &c. (See Ann. Nat. Hist. ser. 2. vol. xvi. pp. 164 &c.) This species occurs also in the Llandeilo rocks of Wales, and in the "Brandschiefer" of the Baltic Provinces (Schmidt).
12. ——— *affinis* ‡, Jones. Tramore, Ireland. *Op. cit.* p. 171.

* This *Brandschiefer* is in the uppermost part of the lowest Silurian group of the Baltic Provinces of Russia; and the Borkholm bed lies higher up, being the uppermost of the Lower Silurian beds. See F. Schmidt's 'Untersuchungen über die Silurische Formation von Esthland, Nord-Livland und Oesel,' 8vo, Dorpat, 1858; and Quart. Journ. Geol. Soc. vol. xiv. pp. 43 *et seq.*

† The Lower Silurian schists at Harnage (near Shrewsbury, in Shropshire), which yield these little Entomostracans, are regarded by the Geological Surveyors as belonging to the Caradoc-Bala formation. Mr. Salter, however, thinks that they may be of Llandeilo age.

‡ In the last edition of 'Siluria,' at page 516, this species is placed by mistake in the Llandeilo column of the Table of Silurian Fossils, and *B. Barrandiana* (a Llandeilo fossil) in the Caradoc Column.

13. *Beyrichia Wilckensiana*, Jones, *op. cit.* p. 89. Horderley, Shropshire.
14. *Cythere Aldensis*, M'Coy, sp. Aldeans, Ayrshire. Respecting this last species it is advisable to give here all the particulars we know of it.

Cythere Aldensis, M'Coy, sp. Pl. VII. fig. 12.

Cytheropsis, n. sp. M'Coy, 1851. Rep. Brit. Assoc. for 1850, Trans. Sect. p. 107.

Cytheropsis Aldensis, M'Coy, 1851. Ann. N. Hist. ser. 2. vol. viii. p. 387.

Cytheropsis Aldensis, M'Coy, 1852. Syst. Descr. Pal. Foss. Geol. Mus. Cambridge, pl. 1 L. fig. 2.

Cytheropsis Aldensis (M'Coy), Salter, 1859. In Murchison's 'Siluria,' 2nd edit. p. 539.

Cythere? *Aldensis* (M'Coy, sp.), Jones, 1867. In Murchison's 'Siluria,' 3rd edit. p. 517.

In his memoir "On some New Cambro-Silurian Fossils," 1851 (Ann. Nat. Hist. *l. c.*), Prof. M'Coy thus describes this species:—

"Arcuato-oblong, dorsal margin much arched, greatest convexity about the middle, sloping more towards the anterior, which is slightly smaller than the posterior end; posterior end broadly arched, anterior end obtusely pointed; a concave flattened sinus, rather more than half the length of the shell, in the ventral margin, rather nearer to the anterior than the posterior end; an obscure roughened spot slightly nearer to the anterior than the posterior end, and slightly nearer to the dorsal than the ventral margin; valves moderately and evenly gibbous; surface very minutely punctured, under a strong lens. Length $1\frac{1}{2}$ millimetre, depth about two-thirds the length.

"This little species is accompanied by a more elongate, oblong, less arched form, of greater rarity, which may either be a distinct species or the male.

"Extremely abundant in the dark earthy limestone of Aldens, Ayrshire."

In the Woodwardian Museum at Cambridge are preserved some specimens of the "Lower Bala" Limestone of Aldeans, collected by Prof. Sedgwick in 1850, and containing several (six or seven) small Bivalved Entomostraca, one of which Prof. M'Coy described as above, and figured in the Brit. Pal. Foss. Camb. Mus. part 2. fasc. 1. pl. 1 L. fig. 2. Through the courtesy of Mr. Harry Seeley, one of us has carefully examined these specimens. They are all imbedded to a greater or less extent in the matrix; and there are at least two distinct forms. One of these we refer to *P. Maccoyii* (see above, p. 56); and the most striking of the others is the specimen figured by Prof. M'Coy. What appears as an obscure tubercle, however,

on the figure is an exaggerated feature, and without importance; in other respects the specimen somewhat resembles our new *Cythere Jukesiana*, but it is much shorter in proportion and more arched. It also approaches some of the *Bairdia* in shape; but its narrow (anterior) extremity has the curvature of a *Cythere*, and is markedly deficient in the peculiar up-turned hatchet-like edge characteristic of *Bairdia*.

C. Aldensis is smaller ($\frac{1}{12}$ inch long) and less convex than the specimen of *Primitia Maccoyii* associated with it in the same limestone.

The name "*Cytheropsis*" has been applied to this and other Palæozoic Entomostraca*. With regard to this term as a generic appellation, we once thought it useful in classifying those Palæozoic Entomostraca that do not closely assimilate either to *Leperditia* or *Beyrichia*, but in outline and size resemble many of the *Cytheræ* of existing seas, though differing from them in having tubercles, relatively thick valves, or other distinctive features (Ann. Nat. Hist. ser. 3. vol. i. p. 249). The establishment, however, of the natural group of *Primitiæ* enables us to bring together several of the "simple *Beyrichiæ*," some of the dubious Leperditoid forms, and nearly all the so-called *Cytheropses*. Indeed of the known species referred to *Cytheropsis* there remain only *C. rugosa* (Jones, Ann. Nat. Hist. ser. 3. vol. i. p. 249, pl. 10. fig. 5), which is probably a *Primitia*, figured upside down, and *C. siliqua* (Jones, *op. cit.* fig. 6), which, perhaps, like some of the Kildare specimens, is a *Cythere* or a *Macrocypris*. Excepting the relatively greater thickness of the valves in some of them (and that is more apparent than real), there is nothing to indicate that these old Entomostraca, which "*Cytheropsis*" was intended to comprise, differed from what now exist as *Cytheræ*, *Bairdiæ*, *Macrocyprides*, &c. The so-called *Cytheropses* of the Carboniferous formations have already been shown to belong to *Leperditia Okeni*, &c. (see Ann. Nat. Hist. ser. 3. vol. xviii. p. 35).

EXPLANATION OF PLATE VII.

- Fig. 1. *Primitia Maccoyii* (full-grown): *a*, right valve; *b*, dorsal, and *c*, ventral aspect.
 Fig. 2. *P. Maccoyii* (intermediate stage of growth): *a*, left valve; *b*, ventral aspect.
 Fig. 3. *P. Maccoyii* (young): *a*, left valve; *b*, ventral aspect; *c*, end view.

* "*Cytheropsis*" has also been applied to a group of recent *Cytheridæ* by G. O. Sars in 1865; but G. S. Brady proposes *Eucythere* in its place for these living forms.

- Fig. 4. *P. Sancti-Patricii*: *a*, right valve; *b*, dorsal aspect.
 Fig. 5. *Cythere Wrightiana*: *a*, left valve; *b*, ventral view.
 Fig. 6. *C. Bailyana*: *a*, right valve; *b*, dorsal view.
 Fig. 7. *C. Jukesiana*: *a*, right valve; *b*, ventral aspect.
 Fig. 8. *C. Harknessiana*: *a*, right valve; *b*, dorsal aspect.
 Fig. 9. *Bairdia Murchisoniana*: *a*, left valve; *b*, ventral view.
 Fig. 10. *B. Griffithiana*: *a*, left valve; *b*, ventral view.
 Fig. 11. *B. Salteriana*: *a*, right valve; *b*, ventral view.
 Fig. 12. *Cythere Aldensis*: right valve.

BIBLIOGRAPHICAL NOTICE.

On Subaërial Denudation, and on Cliffs and Escarpments of the Chalk and the Lower Tertiary Beds. By WILLIAM WHITAKER, B.A., F.G.S., &c. 8vo, pp. 27. Hertford, 1867.

"FOR some years," writes Mr. Whitaker, in this reprint from the 'Geological Magazine,' "geologists have more or less agreed in the view that the present features of the earth, whether hill, valley, or plain (with some small exceptions, as volcanic outbursts), have been formed *directly* by denudation; though *indirectly* disturbances, whether faults, upheavals, or sinkings, have of course had their effect in determining the flow, so to speak, of the denuding agent."

Of late much discussion has been held on the comparative effect of the two forces, disturbance and denudation, and on the relative extent to which sea-action on the one hand and atmospheric agencies on the other have worn away the earth's surface and carved its rocks into their present form.

Although the action, simple or combined, of frost, avalanches, glaciers, icebergs, coast-ice, river-ice, rain, snow-water, springs, torrents, and rivers, has never been ignored by geologists since their science took a systematic form, yet doubtless they have been too much influenced in general by the popular notion that the sea has been up and over the land time after time, and effected the scoopings and carvings of hill and valley,—the quiet and slow action of air and rain (universal, indeed, but lost sight of by the unobservant) having been neglected in many calculations as to the alterations the earth's surface has undergone. Now that advanced knowledge and improved observation have given credit to atmospheric agencies, rather than to marine action, for some of the enormous denudations recognized by geologists in past as well as in present times, we are not at all surprised to find some favouring the new views with such warmth as reaction, enthusiasm, and party-feeling usually create. With an earnest love of truth and of his subject, the writer of this pamphlet has carefully collated the statements of many geologists about "subaërial denudation," showing how much has already been done and thought on the subject; and he adds his own experience and views, somewhat dogmatically and with some contempt for those whom he regards as differing from him.